



SPECIAL REPORT

Electrotechnology-Related Research in the FY 2006 Budget

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HIGHLIGHTS

- ◆ The **National Science Foundation (NSF)** research budget would increase by 2.7 percent to a level of \$4.2 billion, but the President's Budget Request again falls far short of the amount authorized in the NSF authorization bill signed into law in 2002.
- ◆ The **Department of Defense (DOD) R&D** would see the smallest budget increase since the mid 1990's at .1 percent or 71 million. Basic Research (6.1), Applied Research (6.2), Advanced Technology Development (6.3) and Medical Research, known collectively as Science and Technology (S&T) would see an enormous cut of \$2.89 billion to a level of \$10.7 billion – a 21.3 percent decrease. The Defense Advanced Research Projects Agency (DARPA) on the other hand would see a 3.6 percent increase to \$3.1 billion.
- ◆ **NASA's R&D** budget would increase by 4.9 percent to a level of \$11.5 billion. However, aeronautics research would be cut by 5.9 percent, and NASA has canceled a planned robotic servicing mission to repair the Hubble Space Telescope.
- ◆ The double-digit increases of the past two years at the Department of **Homeland Security's R&D** have disappeared in the FY 2006 budget, but the Agency will still receive a healthy 3.9 percent increase for R&D to a level of \$1.3 billion.
- ◆ Research and development at the **Department of Energy Office of Science**, the largest federal supporter of electrotechnology basic research in the United States, would decrease for the second year in a row. For FY 2006, the funding cut will be \$161 million.
- ◆ The **National Nanotechnology Initiative (NNI)** will see its budget drop from \$1.23 billion to a level of \$1.1 billion, despite legislation authorizing much higher amounts.
- ◆ The **Advanced Technology Program** is once again targeted for elimination in the Bush Administration's budget request, as it has been every year since FY 2001. The Manufacturing Extension Program is again targeted for reductions.

INTRODUCTION

The following report is a broad summary of the Bush Administration's proposed FY 2006 funding levels for select electrotechnology R&D programs at the National Science Foundation (NSF), NASA, the Departments of Energy (DOE), Defense (DOD), Homeland Security (DHS), and Commerce and two multi-agency initiatives-the National Nanotechnology Initiative (NNI) and the Networking and Information Technology Research and Development Program (NITRD). The budget figures contained in this analysis are expressed in current dollars and are based on data provided by the federal agencies at the release of the Administration's FY 2006 budget

Electrotechnology research and development, like most other aspects of science and technology R&D, is feeling the squeeze of budget deficit restraints and the Global War on Terror in the FY 2006 President's budget request. Funding for DOD, DOE, NNI, and NITRD is flat or decreasing, but funding for NSF, NASA, DHS and NIST is increasing although NSF funding is far below authorized levels.

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NATIONAL SCIENCE FOUNDATION (NSF)

<http://www.nsf.gov>

On November 21st 2005, the United States Senate confirmed Dr. Ardent L. Bement Jr., a professor of Nuclear Engineering at Purdue University, to be the next Director of the National Science Foundation, replacing Dr. Rita Colwell. When unveiling the FY 2006 budget, Dr. Bement explained that "The Administration has outlined an ambitious agenda for science and engineering in America: continue to create economic growth and opportunity; respond to national needs, including homeland security and cybersecurity; and strive for the efficient and effective use of resources." Dr. Bement said that the NSF is "poised to help the community carry out these responsibilities." But he also warned that it must do so "in a highly constrained budget environment."

This constraint is reflected in the slight 2.4 percent increase to a level of \$5.6 billion, which again falls far below the \$8.5 billion levels authorized by legislation passed in December 2002. This trend has been the pattern every year since the legislation was passed. Dr. Bement acknowledged that the modest increase would allow "little room for growth in research and education programs." Accordingly, the Research and Related Activities (R&RA) budget which funds most of NSF's R&D would increase 2.7 percent, to \$4.3 billion.

According to the budget request, the NSF's funding priorities will focus on the following four major funding areas that it expects to "address the current national challenges and strengthen the core portfolios of NSF's research and education investments."

The listed priorities are:

- Strengthening core disciplinary research
- Providing broadly accessible cyberinfrastructure and world-class research facilities
- Broadening participation in the science and engineering workforce
- Sustaining organizational excellence in NSF management practices

In addition to these priority areas, the NSF supports seven major research areas, or Directorates, including: Biological Sciences (BIO); Computer and Information Science and Engineering (CISE); Education and Human Resources (EHR); Engineering (ENG); Geosciences (GEO); Mathematical and Physical Sciences (MPS); and Social, Behavioral and Economic Sciences (SBE.) It also has accounts for Polar Programs and Major Research Equipment and Facilities Construction (MREFC).

The Computer and Information Science and Engineering Directorate (CISE), which supplies 86 percent of the federal funding for university-based basic computer research, would increase by 1.1 percent to a level of \$621 million. The most significant change in funding levels in CISE is a \$28 million cut in funding for the Information Technology Research (ITR) sub-activity. The NSF Budget Request states that the funds are being transferred to other CISE sub-activity's "to support emerging scientific opportunities and to increase core funding rates." Correspondingly, the funding for the remaining CISE sub-activities, the Computing and Communication Foundations (CCF), Computer and Network Systems (CNS), and the Information and Intelligent Systems (ITS), all increase by around \$11 million.

The Engineering Directorate is the largest gainer among the directorates, and will increase by a relatively robust 3.5 percent, a \$19 million increase over FY 2005. The Directorate funds forty-five percent of all university-based basic engineering research. Under the Engineering Directorate, the Electrical & Communication Systems sub-activity would see a 3.8 percent, or \$3 million increase. The bulk of this increase will go to support "Integrative Systems' principle in the design, development and implementation of new nano/micro/macro/complex and hybrid systems." The Engineering Education and Centers sub-activity budget would likewise increase by \$3 million. The Engineering Directorate is also a large participant in the interagency National Nanotechnology Initiative (NNI), and it will devote \$127.8 million towards Nanoscale Science and Engineering.

The Mathematics and Physical Sciences (MPS) directorate also funds the NSF's participation in the NNI. Between the two directorates, funding for NNI related activities will increase by 1.8 percent to \$344 million.

The NSF's budget for the Math and Science Partnership (MSP) program, a joint program with the Department of Education, would be cut by \$19 million. The Bush Administration plans to shift the majority of MSP funding towards the Department of Education. This plan has been met with some resistance in Congress and by members of the science and technology community. Many feel that the NSF's peer-reviewed program for MSP grants is superior to the block-grant mechanism used by the Department of Education.

For the third year in a row, the funding level for Major Research Equipment and Facilities Construction (MREFC) would receive a large increase. An increase of \$76 million will follow increases of \$55 and \$58 million respectively during the previous two years.

DEPARTMENT OF DEFENSE (DOD)

<http://www.defenselink.mil/>

According to the President's Budget Request, the FY 2006 Department of Defense budget "supports the Global War on Terror (GWOT) by strengthening U.S defense capabilities and keeping U.S. forces combat ready." As demonstrated through such innovations as Laser-guided Weapons Systems, unmanned aerial vehicles (UAVs), stealth bombers, technology continues to play a large part in U.S. defense efforts by providing a "force multiplier" effect. The military's Research, Development, Test and Evaluation (RDT&E) program, is the means by which these advances in military technology are realized.

The RDT&E appropriation provides funding for future military hardware and software and their underlying technologies, covering the full spectrum of R&D from the most basic research to advanced, full-scale, military systems development. RDT&E collectively consists of seven budget activities: Basic Research (6.1), Applied Research (6.2), Advanced Technology Development (6.3), Advanced Component Development (6.4), Systems Development and Demonstration (6.5), Management Support (6.6), and Operational Systems Development (6.7). RDT&E is the federal government's single largest research and development account.

The Department of Defense R&D has been the recipient of some of the largest increases in the federal budget in recent years and it continues to be the largest federal sponsor of R&D, however the President's Budget Request for R&D in the FY 2006 will see the smallest budget increase since the mid-1990s at 0.1 percent, or \$71.0 million.

Hit particularly hard were Basic Research (6.1), Applied Research (6.2), Advanced Technology Development (6.3) and Medical Research, known collectively as Science and Technology (S&T). S&T would see an enormous cut of \$2.89 billion to a level of \$10.7 billion – a 21.3 percent decrease. Each of the services' S&T budgets would be drastically diminished, but the Army would take the brunt of the cuts with a 40 percent, or \$1.16 billion decrease. The Navy is not far behind with a 22.4 percent \$512 million cut, while the Air Force S&T budget was reduced by 15 percent (\$349 million). The single largest budget victim was Army Advance Technology Development (6.3), which was slashed by 45 percent.

The University Research Initiatives program (URI) competitively awards basic research grants to university performers and is funded by the three services. DOD 6.1 funding for URI would fall 15.7 percent down to \$248 million.

RDT&E also funds the Defense Advanced Research Projects Agency (DARPA), whose mission is to "develop imaginative, innovative and often high risk research ideas, offering a significant technological impact that will go beyond the normal evolutionary developmental approaches," is one of the few gainers in the Presidents Budget Request with a 3.6 percent, \$3.1 billion increase.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

<http://www.nasa.gov>

The top priority for the National Aeronautics and Space Administration (NASA) in the FY 2006 budget will be the return-to-flight of the Space Shuttle fleet according to then-NASA Administrator Sean O’Keefe. “The fiscal 2006 NASA budget reaffirms the President’s commitment to the Vision for Space Exploration and provides the next step in implementing it,” said O’Keefe in his statement accompanying the agency’s budget request. The budget is consistent with the plan the Administration outlined last year titled, *Renewed Spirit of Discovery, The President’s Vision for U.S. Space Exploration*, which listed sustained human and robotic space exploration program; a return to the moon, Mars and beyond; and a strategy to develop and improve the "technologies, knowledge and infrastructures" for space exploration as long-term agency goals.

These admittedly ambitious goals are reflected in the NASA R&D budget, which is one of the few bright spots in the entire federal R&D budget. Even though the total NASA budget will increase only slightly, by 1.6 percent, the NASA R&D budget will see a 4.9 percent increase to a total of \$11.5 billion. Much of this increase will go towards R&D for future space exploration to the moon and Mars, including the start of a design competition for the Crew Exploration Vehicle, which NASA hopes to have developed by 2008. Funding for this project is up 113 percent to \$1.1 billion. Robotic moon and Mars missions will also be a high priority as NASA has requested a 17 percent increase to a level of \$585 million for this purpose. The International Space Station (ISS) will also receive a substantial increase – 10.8 percent, or \$1.9 billion.

One item of significant controversy in the FY 2006 budget for the science and technology community and with many members of Congress is NASA’s reversal of its decision, despite recommendations by the National Academy of Science, to send a robot servicing mission to the Hubble Space Telescope (HST) to replace gyroscopes and batteries expected to fail in the next several years. The budget does include \$175 million for “early design activities to safely de-orbit HST, and as appropriate, continued assessment of the feasibility of enhancing the de-orbit mission with a robotic servicing capability.” Citing unacceptable risk, NASA continues to rule out the option of a manned servicing mission.

NASA’s accounts and sub-accounts designations have undergone a significant restructuring in the past several years in response to the Bush Administration’s new focus. The former Space Flight Capabilities (SFC) account has been changed to Exploration Capabilities (EC), which contains the Space Flight enterprise and a new Exploration Systems enterprise. The Space Flight enterprise contains the International Space Station (ISS), the Space Shuttle and Space and Flight Support. The Exploration, Science and Aeronautics (ESA) account is further divided into five separate Enterprises: Space Science, Earth Science, Biological and Physical Research, Aeronautics (formerly Aeronautics Technology), and Education programs.

DEPARTMENT OF HOMELAND SECURITY (DHS)

<http://www.dhs.gov>

The primary mission of the Science and Technology (S&T) Directorate at the Department of Homeland Security (DHS) is to enable research into technology to provide the capabilities to “anticipate, prevent, respond to and recover from terrorist acts.” Commensurate with the priority the Bush Administration places on this activity, the Department of Homeland Security (DHS) continues to defy downward budget pressures felt by other agencies. Although Research and Development at the Department of Homeland Security will not see the double-digit increases of the past two years, it is still slated to receive a healthy 3.6 percent increase to a level of \$1.3 billion – a \$44 million boost over 2005 levels.

Major divisions within the S&T Directorate include Plans Programs & Budget; Research & Development; Homeland Security Advanced Research and Projects Agency (HSARPA); and Systems Engineering and Development. One significant change in the FY 2006 budget is that DHS will consolidate within the Science & Technology (S&T) Directorate the research, development, test and evaluation (RDT&E) activities of all of the departments, including the Transportation Security Administration (TSA), the US Coast Guard (USCG), Customs and Border Protection (CBP), and Information Analysis and Infrastructure Protection (IAIP). According to the budget request, this consolidation will be done in order to “bring the scientific and engineering personnel and other RDT&E resources of the Department under a single accountable authority.”

Major funding priorities within the S&T Directorate for FY 2006 will include \$23 million to expand the capabilities the National Bio and Agrodefense Facility (NBAF), to develop and test the technical means to prevent and recover from attacks on agriculture and humans, plus \$227 million to establish a Domestic Nuclear Detection Office (DNDO). The request also contains \$20 million to develop a Low Volatility Agent (LVA) Warning System for “chemical threat agents whose vapor pressure is sufficiently low that detection by conventional methods is exceptionally difficult.” The budget will also seek to increase funding to \$110 million (up \$49 million) for Counter-MAN Portable Air Defense Systems (C-MANPADS), which conducts research into technical countermeasures for commercial aircraft against the threat of shoulder-fired missiles.

The Homeland Security Advanced Research Project Agency (HSARPA) provides grants for basic and applied research to assist the agency to “conduct rapid prototyping and commercial adaptation,” and to “research revolutionary options.”

DEPARTMENT OF ENERGY (DOE)

<http://www.energy.gov>

On February 1, 2005, Dr. Samuel Bodman, former Deputy Secretary of the Treasury and Deputy Secretary of Commerce, replaced Spencer Abraham as Secretary of Energy. Secretary Bodman is also a former professor of Chemical Engineering at the Massachusetts Institute of Technology. In the statement accompanying his swearing in, Secretary Bodman gave a preview of the Department of Energy’s FY 2006 budget priorities which are “to advance this department’s critically important missions, including preserving America’s pre-eminence in the physical

sciences, ensuring the responsible stewardship of our nation's nuclear weapons stockpile, advancing our international nuclear nonproliferation efforts, and ensuring reliable, secure, affordable and environmentally responsible supplies of energy for our growing economy.”

The Department of Energy budget request touts its record of being “one of the top federal agencies in meeting the challenges of the President’s Management Agenda, including budget and performance integration.” However, the agency’s frugality in 2005 was rewarded with even more belt-tightening in FY 2006 with a \$161 million cut to the DOE's overall R&D budget to a level of \$8.5 billion.

The DOE research and development budget is divided into seven separate accounts: Energy Supply, Science, Fossil Energy, Energy Conservation, Atomic Energy Defense, Clean Coal Technology, and Radioactive Waste Management. The Office of Science, which is the largest supporter of electrotechnology-related basic research in the United States, lists its mission as “[protecting] our national and economic security by providing a world-class scientific research capacity and advancing scientific knowledge.” Research and development in the Office of Science would decrease by 4.5 percent to a level of \$3.2 billion. Within the Office of Science, R&D in the Basic Energy Sciences (BES) program would see an increase of 3.7 percent to a level of \$41 million. The BES program will provide funding for four Nanoscale Research Centers” located at Oak Ridge, Lawrence Berkeley, Argonne, and Sandia/Los Alamos National Laboratories. The DOE is a major contributor and participant in the National Nanotechnology Initiative (NNI).

The FY 2006 Office of Science budget will also contain \$36 million to complete the high-profile research facility construction project, Spallation Neutron Source (SNS), and \$32.5 million for the President’s Hydrogen Fuel Initiative. The Office of Fossil Energy would take a large hit in the DOE R&D budget with a 14.7 percent, \$66 million cut, as would Radioactive Waste Management (\$19 million decrease). The one area to see an increase will be the Office of Energy Supply, which will increase by \$32 million to a level of \$456 million.

NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

<http://www.nano.gov>

Nanotechnology, as classified by the federal government, must satisfy three requirements. It must involve:

- a) "Research and technology development at the atomic, molecular or macromolecular levels, in the length scale of approximately 1-100 nanometer range"
- b) "Creating and using structures, devices and systems that have novel properties and functions because of their small and/or intermediate size" and
- c) "Ability to control or manipulate on the atomic scale"

The National Nanotechnology Initiative (NNI) is a multi-agency nanotechnology research initiative conducted at a total of ten federal agencies. The National Science Foundation, the Department of Defense, the Department of Energy, the National Institutes of Health and NASA are the agencies with the most significant investments in nanotechnology research.

In the FY 2006 budget, NNI would decrease by 2.5 percent to a level of \$1.1 billion, despite the authorization bill signed into law in 2003 by President Bush, the 21st Century Nanotechnology Research & Development Act, which authorized \$3.7 billion for nanotechnology R&D for FY 2005-2008. The NNI was funded at \$1.23 billion in FY 2005. House Science Committee Chairman Sherwood Boehlert (R-NY) put a positive spin on the NNI budget pointing out that, "In a very, very difficult budget year ... nano is holding its own."

NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM (NITRD)

<http://www.nitrd.gov>

Another multi-agency research program of considerable importance is the Networking and Information Technology R&D Program (NITRD). Chartered in 1991 as a collaboration of federal agencies involved in fundamental high-end computer research, seven federal agencies participate in NITRD, including the Department of Defense (DOD), the National Science Foundation (NSF), the Department of Energy (DOE), NASA, the Department of Commerce, and the Environmental Protection Agency (EPA).

As with the National Nanotechnology Initiative and the Climate Change Science Program, the federal government's other multi-agency initiatives, the NITRD budget will likewise face the chopping block in FY 2006. The NITRD Budget will decrease by 6.8 percent to a level of \$1.9 billion.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The National Institute of Standards and Technology (NIST) is a non-regulatory federal agency within the Commerce Department. NIST was founded in 1901 and has a mission to "develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life." In the FY 2006 budget R&D at the National Institute of Standards and Technology (NIST) laboratories would increase by 12.6 percent to \$357 million

Within NIST, the Advanced Technology Program (ATP) is once again targeted for elimination in the Bush Administration's budget request, as it has been every year since FY 2001. ATP's mission is to "accelerate the development of innovative technologies that promise significant commercial payoffs and widespread benefits for the nation." Key defenders in Congress have stepped in to rescue the beleaguered program each year, but this year may be different as former Sen. Ernest Fritz (D-S.C.) who sat on the Appropriations Commerce, Justice, State and the Judiciary Subcommittee (which has jurisdiction over the program) retired in 2004. Congress did not provide funding for new programs in FY 2005 and the FY 2006 budget request seeks to terminate the program in favor of "higher-priority needs."

The Manufacturing Extension Program, which is designed to help small and medium-sized manufacturers get started, is targeted for a 50 percent reduction in FY 2006.

ON-LINE REFERENCES

Budget of the United States Government, Fiscal Year 2006

<http://www.whitehouse.gov/omb/budget/fy2006/>

FY 2006 R&D Budget Materials (Office of Science and Technology Policy)

<http://64.225.252.6/html/budget06.html>

IEEE-USA FY 2006 R&D Budget Resource Page

<http://www.ieeeusa.org/policy/features/FY06researchbudget.html>

AAAS R&D Budget and Policy Program

<http://www.aaas.org/spp/rd/>

Engineering R&D Symposium

<http://www.engineeringpolicy.org/Symposium.html>